CONSTANT ENVELOPE-DELAY VESTIGIAL SIDEBAND VIDEO I.F. AMPLIFIERS

BY

CLARENCE EDWARD BERGMAN

B.S., University of Oklahoma, 1947
M.S., University of Illinois, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ELECTRICAL ENGINEERING
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1950

URBANA, ILLINOIS

1950

CONSTANT ENVELOPE-DELAY VESTIGIAL SIDEBAND VIDEO I.F. AMPLIFIERS

BY

CLARENCE EDWARD BERGMAN

B.S., University of Oklahoma, 1947
M.S., University of Illinois, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ELECTRICAL ENGINEERING
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1950

URBANA, ILLINOIS

1950

R. UNIV.
BIBLIOTHEEK
LEIDEN

CONSTANT ENVELOPE-DELAY VESTIGIAL SIDEBAND VIDEO I.F. AMPLIFIERS

The object of this paper is to present a design for a video i.f. amplifier having optimum transient response while being limited to a bandwidth of less than 6 mc., this being the band of frequencies alloted to a television channel in the United States. Since the audio carrier is located at the upper end of the video channel and the audio carrier for the next lower channel is located at the lower end of the channel considered, an additional constraint is that there must be virtually no transmission at both ends of the pass band. (The relative positions of the audio signals are reversed in a receiver due to the action of the converter.)

The criterion of performance assumed is the response to a suddenly applied sinusoidal voltage. Any system responding well to this signal may be expected to respond well to a television signal.

Two basic types of amplifier design are investigated, one having the gain, the other having the envelope, or time, delay, essentially constant throughout the pass band. Various forms of each of these two types are also considered. For a carrier located at the center of the pass band, the constant amplitude design results in a fast build-up, but it also causes an overshoot of about 9 per cent, with subsequent oscillation or "ringing." The constant time delay design results in a slower build-up but causes no overshoot or ringing.

The transient response of each type of amplifier is developed, by means of the Fourier integral, for the case where the carrier frequency is located at the center of the pass band and also for the case where the carrier is located toward one side of the pass band, giving what is called vestigal, or what may loosely be termed "single," sideband operation. The effects of various types of cut-off are also investigated. Vestigial sideband operation results in a greater effective band-

width, but gives rise to an additional transient response which is in time quadrature with the desired response and which causes a change in the form of the output signal of the amplifier.

From the investigation it is concluded that the time delay should be constant throughout the pass band and that the vestigial sideband arrangement should be used to provide a more rapid build-up. It is also concluded that a bridged "T" network may be used to block the audio i.f. signals present while having negligible effect upon the characteristics of the video i.f. amplifier proper.

Experimental results are obtained using amplifiers built up of cascaded stagger-tuned parallel resonance circuits connected by vacuum tubes. The experimental results are in general agreement with the theoretical results. The blocking circuits are found to have negligible effect upon the transient response of the amplifiers.

The constant time delay, or linear phase, type of design makes it desirable to measure the phase shift through the amplifier throughout the pass band. A method by which this may be done is presented, along with a suggested method of showing the phase shift versus frequency curve upon an oscilloscope screen.

VITA

Clarence Edward Bergman was born on July 4, 1926, in St. Louis, Missouri. After graduating from Southwest High School of that city in 1944, he entered the Navy V-12 program. Under Navy auspices, he attended Central College, Fayette, Missouri from March to November of 1944, and attended the University of Oklahoma from November, 1944, to June, 1946. At that time he was commissioned an Ensign, USNR, and was assigned to duty in the American and Atlantic Areas. Upon release to inactive duty in January, 1947, he re-entered the University of Oklahoma, from which he received the degree of Bachelor of Science in June of that year. In the following July he entered the Graduate College of the University of Illinois, where he held a Motorola Fellowship in the academic year 1947-48 and received the degree of Master of Science in February, 1948. During the academic year 1948-49, he held a E. I. du Pont de Nemours and Company Fellowship, and he held a Teaching Assistantship from September, 1949, to February, 1950.

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41549816_0135